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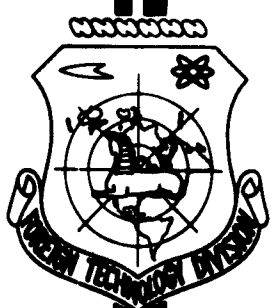
TRANSLATION

POPPED PERLITE AND ARTICLES BASED THEREON

FOREIGN TECHNOLOGY DIVISION



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UNEDITED ROUGH DRAFT TRANSLATION

POPPED PERLITE AND ARTICLES BASED THEREON

Author Not Given

English Pages: 10

T-67

PREPARED BY:

TRANSLATION DIVISION
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VSPUCHENNYY PERLIT I IZDELIYA NA EGO OSNOVA

Akademiya Stroitel'stvai Arkhitektury USSR
Kiev - 1961

Pages: 1-10

FTD-TT-63-354/1+2+4

POPPED PERLITE AND ARTICLES BASED THEREON

Popped perlitic sand is an extremely light highly-efficient heat- and sound-insulating material, of inorganic origin, obtained by the rapid firing of certain acid vulcanic vitreous perlitic rock in a suspended state at a temperature of 900-1150°.

Popped perlitic sand is used for the preparation of light heat-insulating and sound-insulating mortars and concretes as materials for fill insulating, a filter material for agressive fluids, an additive to textured paint and for the purpose of heat-mount insulation.

Physicomechanical Features

Raised perlitic sand is refractory, non-absorbent, chemically inert, biologically stable and has no odor with a unit weight of 80-200 kg/m3 and thermal conductivity of 0.04-0.05 kcal/m.hr.deg.

In the Ukrainian SSR, according to the engineering plan and technological documentation of construction developed by the Scientific-Research Institute of Structural Materials and Products of the Academy of Construction and Architecture of the Ukrainian SSR, (NIISMI ASiA USSR), six plants for the preparation of popped perlitic sand from Transcarpathian perlitic stone with a unit weight of 80-180 kg/m3 were

constructed and are operating. The NIISMI ASiA USSR developed the engineering and technological documentation on the construction of a plant with a capacity of 5, 10, 25 and 40 thousand cubic meters of popped perlite. Technological documentation is being developed for the construction of a standard plant with a capacity of 45 thousand cubic meters of popped perlite.

Eight perlite establishments are planned for construction in the Ukrainian SSR this year.

Description of the Technological Process and Apparatus for the Popping of Perlite

Popped Perlitic Sand

Perlitic rock is crushed in a jaw-breaker, pulverized in a roller mill, and dispersed into three fractions. The coarsest fraction (>20 mm) is returned for a second grinding in the roller mill. The second (1.0-2.0 mm) and third (0.0-1.0 mm) fractions are directed to a furnace assembly for separate popping since, depending on the degree of pulverization, the basic parameters, (temperature and pressure in the furnace) are varied.

The resultant popped perlitic sand enters an air-classification system. The perlitic sand which settles in dust extractors is packed in multilayer paper bags and proceeds to the warehouse of finished products.

A vertical shaft furnace consisting of five stacked sections is used to pop the perlite. In order to reduce sticking of the calcined material the three lower sections have water-cooled walls lined with refractory material 30-40 mm thick. The fourth and fifth (upper) sections are cylinders with double walls between which air is circulated

for cooling.

The design allows for the possibility of using pre-heated air in in the lower section of the furnace where the gas is burned; for this purpose there are special air ducts with control valves. The furnace is heated with natural gas (Dashava) with a thermal capacity of 8,500 kcal/m^3, or with liquid fuel.

In order to asure mechanized rhythmic loading of raw material into the furnace a receiving funnel for the raw material is provided at the base of the shaft. From here the pulverized material proceeds along a vertical screw conveyor into the loading funnel of the disk feeder. From the feeder the raw material proceeds through a special funnel into the furnace and, entering the zone of maximum temperature, is popped. The light popped particles are carried upward by the gas flow and, as a result of the vacuum produced by an exhaust fan, move into the air-separation system.

The furnace is suspended on a specially mounted metal frame. The maintenance equipment and platform are mounted on metal columns.

Remote control is provided for ease of maintenance of the furnace.

Popped Perlitic Chips

The popped chips are introduced into rotary furnaces with subsequent separation of fine and dust fractions in an air-separation system.

The unit weight of the popped perlitic chips is 280-350 kg/m^3.

Application of Popped Perlite

Perlitic rock is effectively used for the manufacture of heat-insulating products, mortars and cements.

Heat-insulating articles on a perlite base may be used at temperatures up to 800° and for filling each from -180 to +800-900°, which has

important significance in conditions of the continuously increasing parameters of heat-transfer agents and for refrigeration plants.

The forms of perlite articles recommended for insulation of energy and technological equipment are listed in Table 1.

TABLE 1

Type of article	Unit weight kg/m^3	Thermal conductivity, kcal/m·hr·deg	Strength kg/cm^3	
			compression	bending
Ceramoperlitic	300—400	0,07	10—16	—
Fire-proof, with cement binder	300—400	0,08	—	5,6
Fire-proof, with concrete clay	250—300	0,075	—	5,7
On a base (synthetic resin)	200—250	0,05	—	5,6

Economic calculations have shown perlitic construction heat-insulating products to be very cheap, when mass produced, as compared to other high-efficiency heat-insulating products.

The following combinations of thermal plaster mixtures of perlitic sand and structural gypsum have been developed.

Physicomechanical Properties

of Gypsum-Perlite Mortar

Unit weight, t/m^3 .....0.45-0.55
Compression strength, kg/cm^2 15-35
Bending strength, kg cm^2..... 4-5
Thermal conductivity in an air-dry condition, kcal/m·hr·degree 0.16

Expediture of Material Per 1 m^3 of Mixture

Gypsum	300-330 kg
Perlite	130-160 kg

Ceramoperlitic Heat Insulators in the Form of Plates and Shells

The technology of preparing heat-insulating products with low thermal conductivity on a popped perlite base with a binder of pliable clay for use at temperatures to 800° has been developed.

Physicomechanical Properties of Ceramoperlitic Products

Unit weight, kg/m^3	300-400
Compression strength, kg/cm^2	15-35
Thermal conductivity for a unit weight of 292-355 kg/cm^3, kcal/cm·hr·degree	0.064-0.080
Temperature coefficient (increase in thermal conductivity with temperature increase)	0.00018
Refractoriness (depending on the clay used)	1320-1460
Additional shrinkage, %:	
at 900°	—
at 950-1000°	7-12

Thermal Inserts for the Insulation of Wall Panels

Gypsoperlite. The basic physicomechanical properties of gypsoperlitic products are presented in Table 2.

Expenditure of Material Per 1 m^3 of gypsoperlite

Gypsum	300-430 kg
Perlite	155-160 kg

TABLE 2

Composition by volume (gypsum, perlite)	Consistency of mixture according to the cone of the Construction Central Scientific Research Laboratory cm	Unit wt. t/m^3	Compression strength in dry state, kg/cm^2	Thermal conductivity in air-dry state, kcal/m·hr·deg
1:2	7	0.65	25	0.21
1:3	7	0.50	15	0.16

The products are cast.

Perlite and silicate. Heat-insulating materials of autoclave hardening were obtained on a base of lime-sand substances and perlite, and have the following physico-mechanical characteristics:

Unit weight, t/m^3 ..... 0.5-0.7
Compression strength, kg/cm^3. 15-30
Thermal conductivity in air dry condition, kcal/m·hr·degree 0.12-0.20

Expenditure of Material Per 1 m of Product

Lime ..... 30-50 kg/m^3
Perlite ..... 150-200 "
Sand ..... 250-450 "

The articles are formed by the plastic method with subsequent vibration, and are subjected to autoclave treatment.

Perlite-concrete on a cement base. Perlite-concretes are divided into two groups according to their purpose:

1) heat-insulating – unit weight of the concrete in air-dry condition 350-600 kg/m^3; grades 10, 15 and 25.

2) structural heat-insulating – unit weight of the concrete in air-dry condition 700-1,100 kg/m^3; grades 35, 50 and 75.

Structural heat-insulating concretes are prepared using perlitic sand in a light coarse aggregate such as clay filler, pumice slag (raised blast-furnace slag), agloporite and others, with unit weights no greater than 500-650 kg/m^3.

The Characteristics of Structural Heat-Insulating Perlite-Concrete

The composition and unit weight of perlite-concretes with coarse aggregate, given in Table 3, are obtained using a clay filler with a unit weight of 500-600 kg/m^3 and perlitic sand with a unit weight of 140-150 kg/m^3. The unit weight of perlitic sand of the indicated compositions of perlite-cement without coarse aggregate amounts to 120-130 kg/m^3.

TABLE 3

Perlite-cement designation	composition by volume (cement, perlite, clay filler)	water/cement ratio	Unit weight in dry state kg/m^3	Amount of cement per 1 m^3, kg	Cement grade	Thermal conductivity, kcal/m·hr·degree
Heat-insulating	1:6	1.5	500	260	25	0,18
	1:8	1,7	450	200	15—25	0,16
	1:10	2,0	400	150	15	0,14
	1:15	2,5	350	110	10	0,13
Structural heat-insulating clay-filled perlite-cement	1:2, 34:3,92	0,75	820	250	35	0,26
	1:1, 73:3,48	0,68	930	280	50	0,30
	1:2, 32:2,92	0,70	1000	330	75	0,32

Asphalt-Perlite

The "Khimmetallurgstroy" Trust of the Stanislav Council of the National Economy together with the Scientific Research Institute of Structural Materials and Products of the Academy of Construction and Architecture of the Ukrainian SSR developed the technology of the production of new high-efficiency heat- and hydro-insulating perlite-cement on a base of asphalt and other organic binders.

Asphalt-perlite is a heat- and hydro-insulating cement obtained by combining popped perlitic dust and asphalt in special heated mixers.

Physicomechanical Properties of Asphalt-Perlite

Unit weight, kg/m^3 350-400
Compression strength, kg/cm^2... 4-7
Water-absorption in 24 hrs (in %) ..... not greater than 1
Thermal conductivity of air-dry state, kcal/m·hr·deg..0.08-0.10

Area of Application of Asphalt-Perlite

Asphalt-perlite is used for heat- and hydro-insulation of the structural elements of buildings. In particular, an asphalt-perlite covering is being used successfully by the Khimmetallurgstroy Trust as a heat-insulating coating for flat-roofed industrial, governmental, and residential buildings; then there is no need for vapor insulations or tightening devices. In addition, asphalt-perlite may be used as a material having good sound-absorbing properties.

Comparitive Characteristics of the Cost of Coating

One Square Meter

(according to Khimmetallurgstroy data)

Using cellular concrete

vapor-insulation	0.324	rubles
9 cm cellular cement layer..	2.940	"
asphalt crust	0.750	"
three-layer roofing material	1.820	"
Total	5.834	rubles

Using asphalt-perlite

6 cm asphalt-perlite layer	0.852	rubles
three-layer roofing material	1.820	"
Total	2.672	rubles

As can be seen from the factual data, the cost of 1 m^2 of asphalt-perlite coating is 54.5% lower.

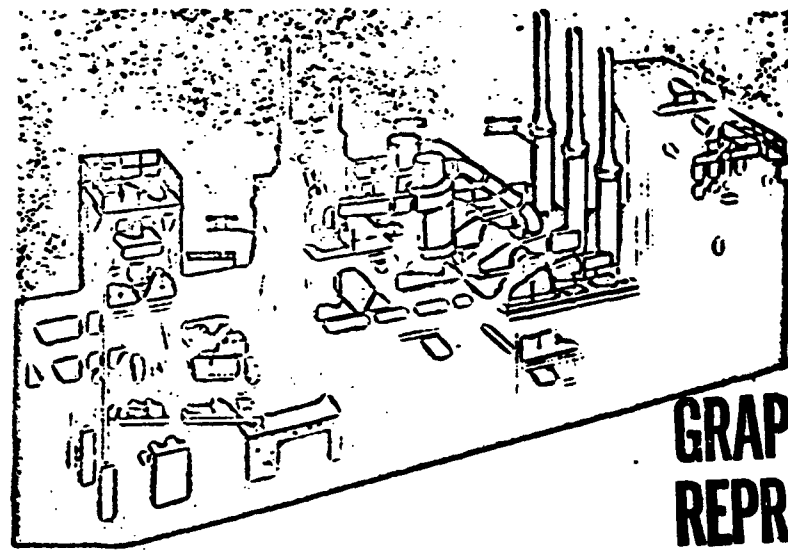

Fig. 1. Plant for the production of popped perlitic sand.

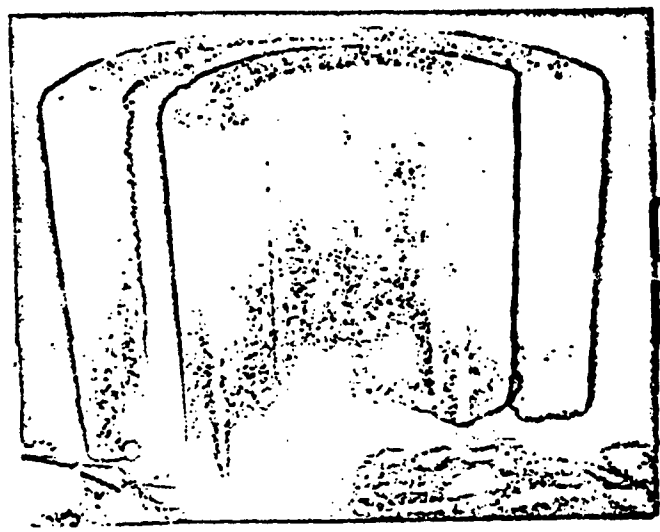

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Fig. 2. Ceramoperlitic shell for insulating pipes.

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